

1:4 LVPECL Fanout Buffer with Selectable Clock Input

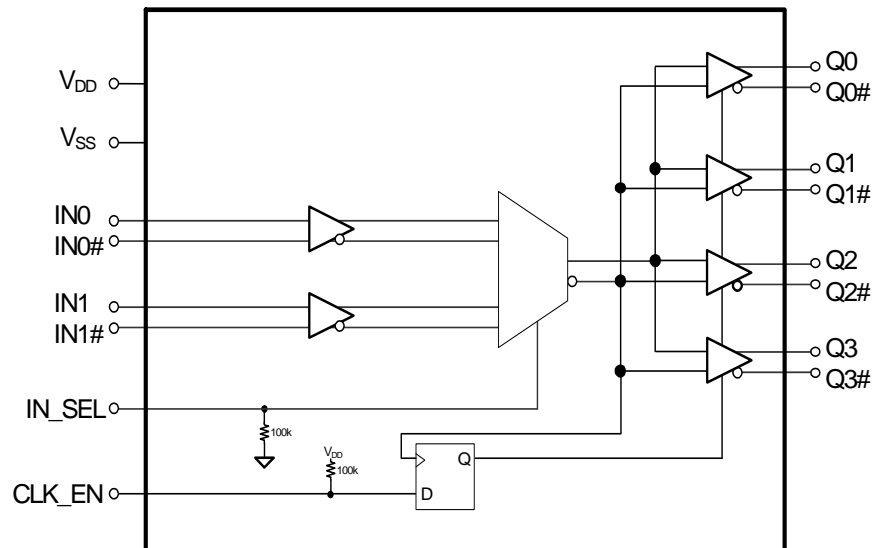
Features

- Select one of two low-voltage positive emitter-coupled logic (LVPECL) input pairs to distribute to four LVPECL output pairs
- 30 ps maximum output-to-output skew
- 480-ps maximum propagation delay
- 0.15-ps maximum additive RMS phase jitter at 156.25 MHz (12-kHz to 20-MHz offset)
- Up to 1.5-GHz operation
- Synchronous clock enable function
- 20-pin thin shrunk small outline package (TSSOP)
- 2.5-V or 3.3-V operating voltage^[1]
- Commercial and industrial operating temperature range

Functional Description

The CY2DP1504 is an ultra-low noise, low-skew, low-propagation delay 1:4 LVPECL fanout buffer targeted to meet the requirements of high-speed clock distribution applications. The CY2DP1504 can select between two separate LVPECL input clock pairs using the IN_SEL pin. The synchronous clock enable function ensures glitch-free output transitions during enable and disable periods. The device has a fully differential internal architecture that is optimized to achieve low additive jitter and low skew at operating frequencies of up to 1.5 GHz.

Logic Block Diagram



Note

1. Input AC-coupling capacitors are required for voltage-translation applications.

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Pinouts

Figure 1. Pin Diagram – 20-Pin TSSOP Package

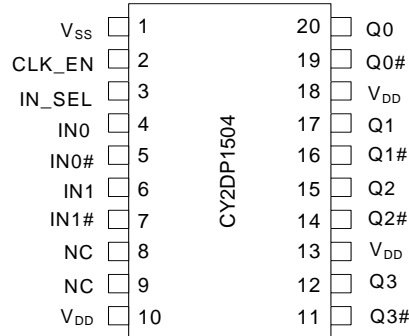


Table 1. Pin Definitions

Pin No.	Pin Name	Pin Type	Description
1	V _{SS}	Power	Ground
2	CLK_EN	Input	Synchronous clock enable. Low-voltage complementary metal oxide semiconductor (LVCMOS)/low-voltage transistor-transistor-logic (LVTTTL). When CLK_EN = Low, Q(0:3) outputs are held Low and Q(0:3)# outputs are held High
3	IN_SEL	Input	Input clock select pin. LVCMOS/LVTTTL; When IN_SEL = Low, the IN0/IN0# differential input pair is active When IN_SEL = High, the IN1/IN1# differential input pair is active
4	IN0	Input	LVPECL input clock. Active when IN_SEL = Low
5	IN0#	Input	LVPECL complementary input clock. Active when IN_SEL = Low
6	IN1	Input	LVPECL input clock. Active when IN_SEL = High
7	IN1#	Input	LVPECL complementary input clock. Active when IN_SEL = High
8,9	NC		No connection
10,13,18	V _{DD}	Power	Power supply
11,14,16,19	Q(0:3)#	Output	LVPECL complementary output clocks
12,15,17,20	Q(0:3)	Output	LVPECL output clocks

Absolute Maximum Ratings

Parameter	Description	Condition	Min	Max	Unit
V_{DD}	Supply voltage	Nonfunctional	-0.5	4.6	V
$V_{IN}^{[2]}$	Input voltage, relative to V_{SS}	Nonfunctional	-0.5	lesser of 4.0 or $V_{DD} + 0.4$	V
$V_{OUT}^{[2]}$	DC output or I/O voltage, relative to V_{SS}	Nonfunctional	-0.5	lesser of 4.0 or $V_{DD} + 0.4$	V
T_S	Storage temperature	Non functional	-55	150	°C
ESD_{HBM}	Electrostatic discharge (ESD) protection (Human body model)	JEDEC STD 22-A114-B	2000	-	V
L_U	Latch up		Meets or exceeds JEDEC Spec JESD78B IC Latchup Test		
UL-94	Flammability rating	At 1/8 in	V-0		
MSL	Moisture sensitivity level		3		

Operating Conditions

Parameter	Description	Condition	Min	Max	Unit
V_{DD}	Supply voltage	2.5-V supply	2.375	2.625	V
		3.3-V supply	3.135	3.465	V
T_A	Ambient operating temperature	Commercial	0	70	°C
		Industrial	-40	85	°C
t_{PU}	Power ramp time	Power-up time for V_{DD} to reach minimum specified voltage (power ramp must be monotonic).	0.05	500	ms

Note

2. The voltage on any I/O pin cannot exceed the power pin during power up. Power supply sequencing is not required.

DC Electrical Specifications

($V_{DD} = 3.3\text{ V} \pm 5\%$ or $2.5\text{ V} \pm 5\%$; $T_A = 0\text{ }^\circ\text{C}$ to $70\text{ }^\circ\text{C}$ (Commercial) or $-40\text{ }^\circ\text{C}$ to $85\text{ }^\circ\text{C}$ (Industrial))

Parameter	Description	Condition	Min	Max	Unit
I_{DD}	Operating supply current	All LVPECL outputs floating (internal I_{DD})	–	61	mA
V_{IH1}	Input high voltage, LVPECL input clocks IN0 and IN0#, IN1 and IN1#		–	$V_{DD} + 0.3$	V
V_{IL1}	Input low voltage, LVPECL input clocks IN0 and IN0#, IN1 and IN1#		–0.3	–	V
V_{IH2}	Input high voltage, CLK_EN, IN_SEL	$V_{DD} = 3.3\text{ V}$	2.0	$V_{DD} + 0.3$	V
V_{IL2}	Input low voltage, CLK_EN, IN_SEL	$V_{DD} = 3.3\text{ V}$	–0.3	0.8	V
V_{IH3}	Input high voltage, CLK_EN, IN_SEL	$V_{DD} = 2.5\text{ V}$	1.7	$V_{DD} + 0.3$	V
V_{IL3}	Input low voltage, CLK_EN, IN_SEL	$V_{DD} = 2.5\text{ V}$	–0.3	0.7	V
$V_{ID}^{[3]}$	Input differential amplitude	See Figure 2 on page 7	0.4	1.0	V
V_{ICM}	Input common mode voltage	See Figure 2 on page 7	0.5	$V_{DD} - 0.2$	V
I_{IH}	Input high current, all inputs	Input = $V_{DD}^{[4]}$	–	150	μA
I_{IL}	Input low current, all inputs	Input = $V_{SS}^{[4]}$	–150	–	μA
V_{OH}	LVPECL output high voltage	Terminated with $50\ \Omega$ to $V_{DD} - 2.0^{[5]}$	$V_{DD} - 1.20$	$V_{DD} - 0.70$	V
V_{OL}	LVPECL output low voltage	Terminated with $50\ \Omega$ to $V_{DD} - 2.0^{[5]}$	$V_{DD} - 2.0$	$V_{DD} - 1.63$	V
R_P	Internal pull-up/pull-down resistance, LVCMOS logic inputs	CLK_EN has pull-up only IN_SEL has pull-down only	60	140	$\text{k}\Omega$
C_{IN}	Input capacitance	Measured at 10 MHz; per pin	–	3	pF

Notes

- V_{ID} minimum of 400 mV is required to meet all output AC Electrical Specifications. The device is functional with V_{ID} minimum of greater than 200 mV.
- Positive current flows into the input pin, negative current flows out of the input pin.
- Refer to [Figure 3](#) on page 7.

AC Electrical Specifications

($V_{DD} = 3.3\text{ V} \pm 5\%$ or $2.5\text{ V} \pm 5\%$; $T_A = 0\text{ }^\circ\text{C}$ to $70\text{ }^\circ\text{C}$ (Commercial) or $-40\text{ }^\circ\text{C}$ to $85\text{ }^\circ\text{C}$ (Industrial))

Parameter	Description	Condition	Min	Typ	Max	Unit
F_{IN}	Input frequency		DC	–	1.5	GHz
F_{OUT}	Output frequency	$F_{OUT} = F_{IN}$	DC	–	1.5	GHz
V_{PP}	LVPECL differential output voltage peak to peak, single-ended. Terminated with $50\ \Omega$ to $V_{DD} - 2.0$ ^[6]	$F_{out} = \text{DC to } 150\text{ MHz}$	600	–	–	mV
		$F_{out} = >150\text{ MHz to } 1.5\text{ GHz}$	400	–	–	mV
t_{PD} ^[7]	Propagation delay input pair to output pair	Input rise/fall time < 1.5 ns (20% to 80%)	–	–	480	ps
t_{ODC} ^[8]	Output duty cycle	50% duty cycle at input Frequency range up to 1 GHz	48	–	52	%
t_{SK1} ^[9]	Output-to-output skew	Any output to any output, with same load conditions at DUT	–	–	30	ps
$t_{SK1 D}$ ^[9]	Device-to-device output skew	Any output to any output between two or more devices. Devices must have the same input and have the same output load.	–	–	150	ps
PN_{ADD}	Additive RMS phase noise 156.25 MHz Input Rise/fall time < 150 ps (20% to 80%) $V_{ID} > 400\text{ mV}$	Offset = 1 kHz	–	–	–120	dBc/Hz
		Offset = 10 kHz	–	–	–130	dBc/Hz
		Offset = 100 kHz	–	–	–135	dBc/Hz
		Offset = 1 MHz	–	–	–145	dBc/Hz
		Offset = 10 MHz	–	–	–153	dBc/Hz
		Offset = 20 MHz	–	–	–155	dBc/Hz
t_{JIT} ^[10]	Additive RMS phase jitter (Random)	156.25 MHz, 12 kHz to 20 MHz offset; input rise/fall time < 150 ps (20% to 80%), $V_{ID} > 400\text{ mV}$	–	–	0.15	ps
t_R, t_F ^[11]	Output rise/fall time	50% duty cycle at input, 20% to 80% of full swing (V_{OL} to V_{OH}) Input rise/fall time < 1.5 ns (20% to 80%)	–	–	300	ps
t_{SOD}	Time from clock edge to outputs disabled	Synchronous clock enable (CLK_EN) switched Low	–	–	700	ps
t_{SOE}	Time from clock edge to outputs enabled	Synchronous clock enable (CLK_EN) switched High	–	–	700	ps

Notes

6. Refer to Figure 3 on page 7.
7. Refer to Figure 4 on page 7.
8. Refer to Figure 5 on page 7.
9. Refer to Figure 6 on page 8.
10. Refer to Figure 7 on page 8.
11. Refer to Figure 8 on page 8.

Figure 2. Input Differential and Common Mode Voltages

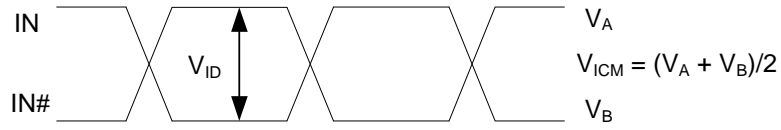


Figure 3. Output Differential Voltage

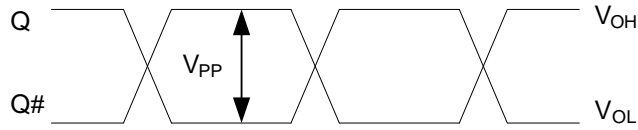


Figure 4. Input to Any Output Pair Propagation Delay

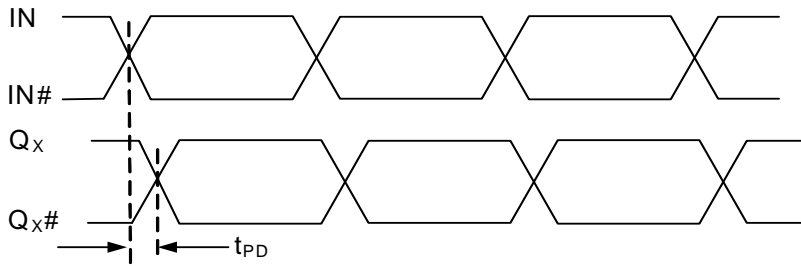


Figure 5. Output Duty Cycle

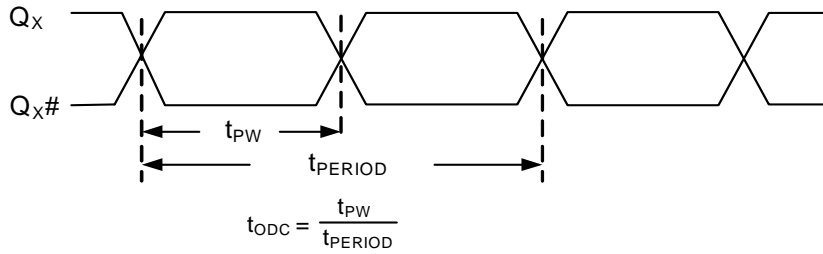


Figure 6. Output-to-Output and Device-to-Device Skew

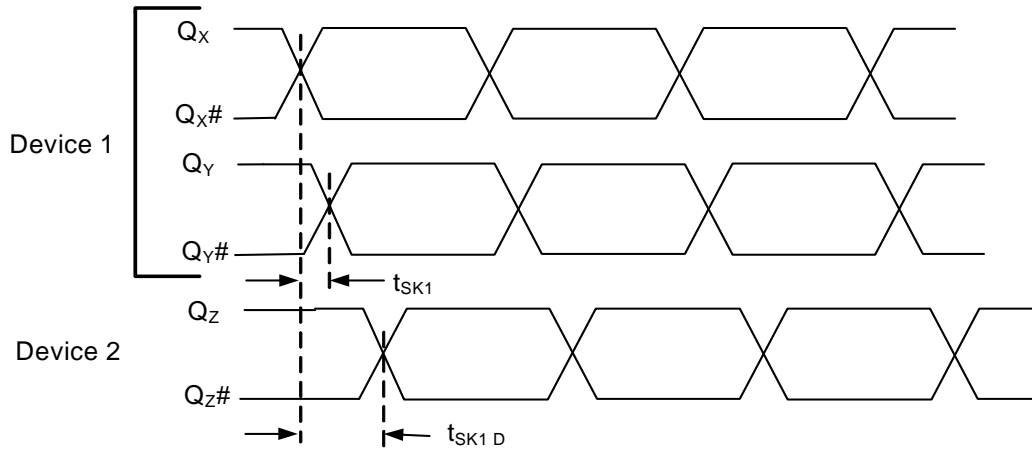


Figure 7. RMS Phase Jitter

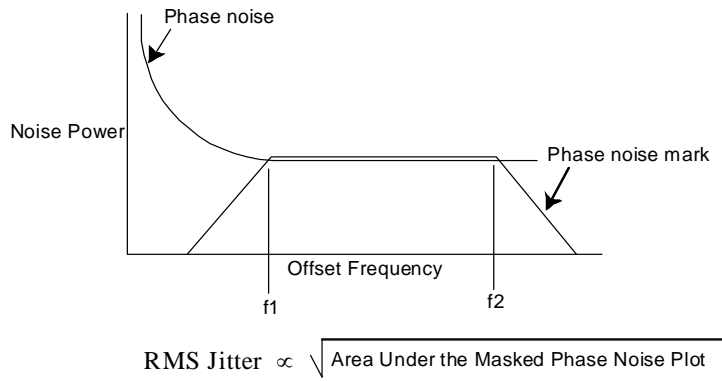


Figure 8. Output Rise/Fall Time

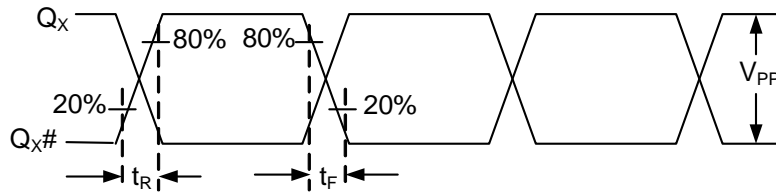
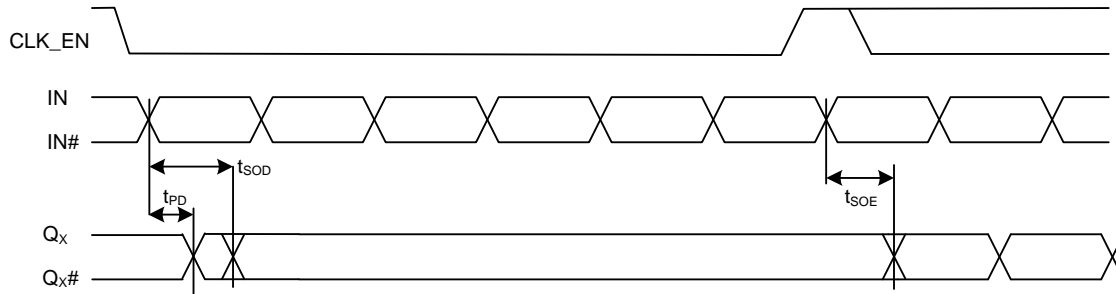


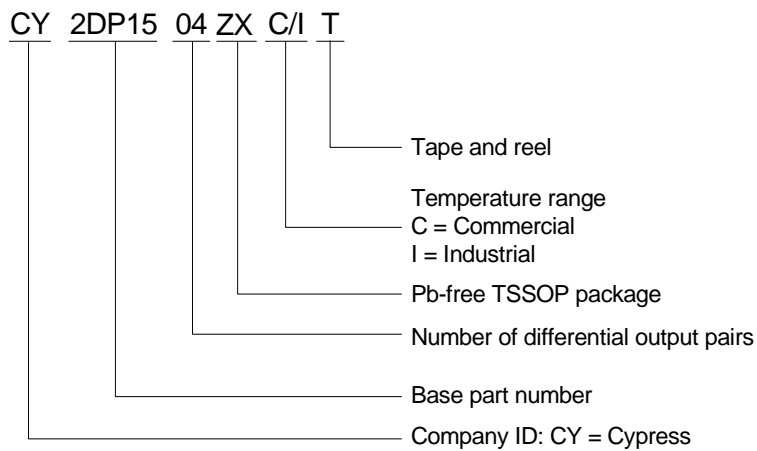
Figure 9. Synchronous Clock Enable Timing



Ordering Information

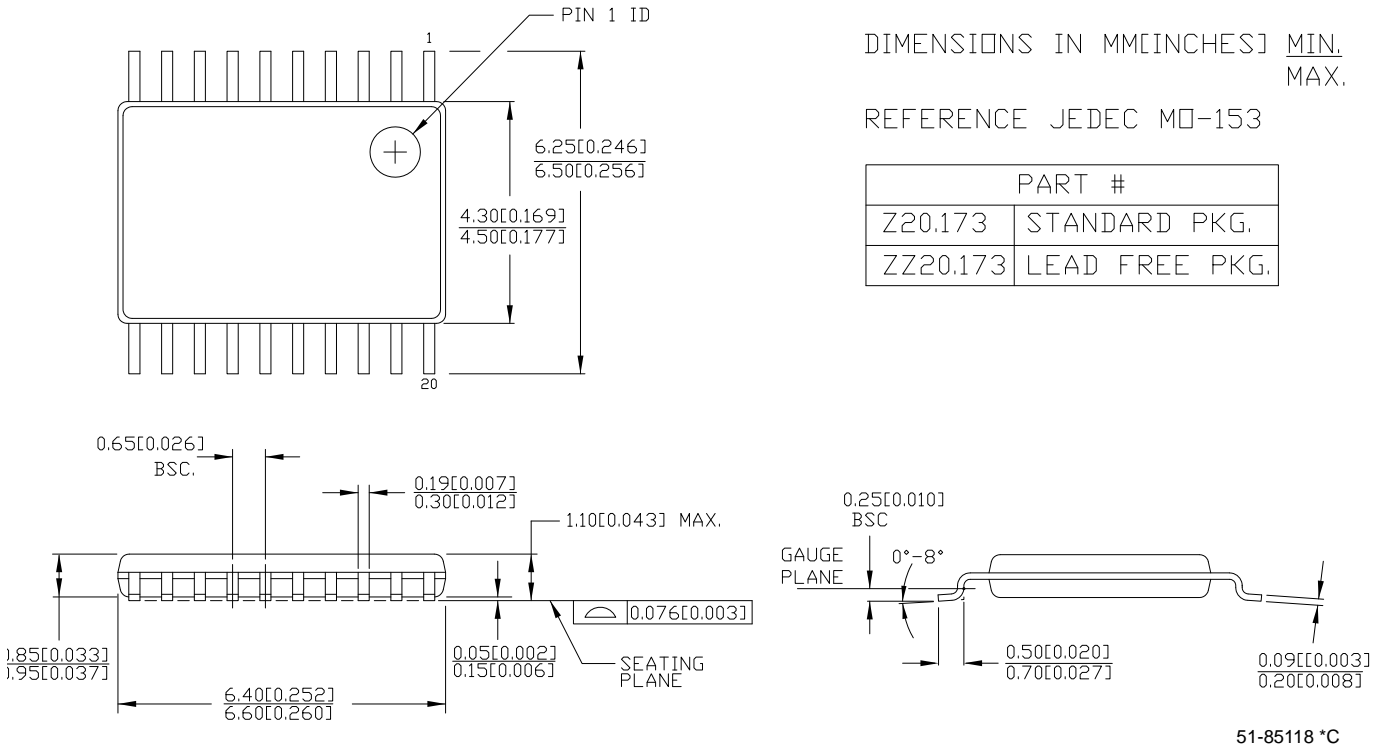
Part Number	Type	Production Flow
Pb-free		
CY2DP1504ZXC	20-Pin TSSOP	Commercial, 0 °C to 70 °C
CY2DP1504ZXCT	20-Pin TSSOP tape and reel	Commercial, 0 °C to 70 °C
CY2DP1504ZXI	20-Pin TSSOP	Industrial, -40 °C to 85 °C
CY2DP1504ZXIT	20-Pin TSSOP tape and reel	Industrial, -40 °C to 85 °C

Ordering Code Definition



Package Dimension

Figure 10. 20-Pin Thin Shrunk Small Outline Package (4.40 mm Body) ZZ20



Acronyms

Table 2. Acronyms Used in this Document

Acronym	Description
ESD	electrostatic discharge
HBM	human body model
JEDEC	Joint electron devices engineering council
LVMOS	low-voltage complementary metal oxide semiconductor
LVPECL	low-voltage positive emitter-coupled logic
LVTTTL	low-voltage transistor-transistor logic
OE	Output enable
RMS	root mean square
TSSOP	thin shrunk small outline package

Document Conventions

Table 3. Units of Measure

Symbol	Unit of Measure
°C	degree Celsius
dBc	decibels relative to the carrier
GHz	giga hertz
Hz	hertz
kΩ	kilo ohm
μA	microamperes
μF	micro Farad
μs	microsecond
mA	milliamperes
ms	millisecond
mV	millivolt
MHz	megahertz
ns	nanosecond
Ω	ohm
pF	pico Farad
ps	pico second
V	volts
W	watts

Document History Page

Document Title: CY2DP1504 1:4 LVPECL Fanout Buffer with Selectable Clock Input				
Document Number: 001-56215				
Revision	ECN	Orig. of Change	Submission Date	Description of Change
**	2782891	CXQ	10/09/09	New Datasheet.
*A	2838916	CXQ	01/05/2010	<p>Changed status from "ADVANCE" to "PRELIMINARY".</p> <p>Changed from 0.34 ps to 0.25 ps maximum additive jitter in "Features" on page 1 and in t_{JIT} in the AC Electrical Specs table on page 5.</p> <p>Added t_{PU} spec to the Operating Conditions table on page 3.</p> <p>Changed max I_{DD} spec in the DC Electrical Specs table on page 4 from 60 mA to 61 mA.</p> <p>Change V_{OH} in the DC Electrical Specs table on page 4: minimum from $V_{DD} - 1.15V$ to $V_{DD} - 1.20V$; maximum from $V_{DD} - 0.75V$ to $V_{DD} - 0.70V$.</p> <p>Removed V_{OD} spec from the DC Electrical Specs table on page 4.</p> <p>Added R_P spec in the DC Electrical Specs table on page 4. Min = 60 kΩ, Max = 140 kΩ.</p> <p>Added a measurement definition for C_{IN} in the DC Electrical Specs table on page 4.</p> <p>Added V_{PP} spec to the AC Electrical Specs table on page 5. V_{PP} min = 600 mV for DC - 150 MHz and min = 400 mV for 150 MHz to 1.5 GHz.</p> <p>Changed letter case and some names of all the timing parameters in the AC Electrical Specs table on page 5 to be consistent with EROS.</p> <p>Lowered all additive phase noise mask specs by 3 dB in the AC Electrical Specs table on page 5.</p> <p>Added condition to t_R and t_F specs in the AC Electrical specs table on page 5 that input rise/fall time must be less than 1.5 ns (20% to 80%).</p> <p>Changed letter case and some names of all the timing parameters in Figures 3, 4, 5, 6 and 8, to be consistent with EROS.</p>
*B	3011766	CXQ	08/20/2010	<p>Changed maximum additive jitter from 0.25 ps to 0.11 ps in "Features" on page 1 and in t_{JIT} in the AC Electrical Specs table.</p> <p>Added note 3 to describe I_{IH} and I_{IL} specs.</p> <p>Removed reference to data distribution from "Functional Description".</p> <p>Changed R_P for differential inputs from 100 kΩ to 150 kΩ in the Logic Block Diagram and from 60 kΩ min / 140 kΩ max to 90 kΩ min / 210 kΩ max in the DC Electrical Specs table.</p> <p>Added max V_{ID} of 1.0V in DC Electrical Specs table.</p> <p>Updated phase noise specs for 1 k/10 k/100 k/1 M/10 M/20 MHz offset to -120/-130/-135/-150/-150/-150dBc/Hz, respectively, in the AC Electrical Specs table.</p> <p>Added "Frequency range up to 1 GHz" condition to t_{ODC} spec.</p> <p>Updated package diagram.</p> <p>Added Acronyms and Ordering Code Definition.</p>
*C	3017258	CXQ	08/27/2010	Corrected Output Rise/Fall time diagram.
*D	3100234	CXQ	11/18/2010	<p>Updated Phase jitter to 0.15ps max from 0.11ps max.</p> <p>Changed V_{IN} and V_{OUT} specs from 4.0V to "lesser of 4.0 or $V_{DD} + 0.4$"</p> <p>Removed 200mA min LU spec, replaced with "Meets or exceeds JEDEC Spec JESD78B IC Latchup Test"</p> <p>Removed R_P spec for differential input clock pins IN_X and $IN_X\#$.</p> <p>Changed C_{IN} condition to "Measured at 10 MHz".</p> <p>Changed PN_{ADD} specs for 1MHz, 10MHz, and 20MHz offsets.</p> <p>Removed t_S and t_H specs from AC specs table.</p>
*E	3135201	CXQ	01/12/2011	<p>Removed "Preliminary" status heading.</p> <p>Removed resistors from $IN_X/IN_X\#$ in Logic Block Diagram.</p> <p>Added Figure 9 to describe T_{SOE} and T_{SOD}.</p>
*F	3090938	CXQ	02/25/2011	Post to external web.

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